Beyond Zero Emissions
FutureGen Conceptual Design Retort.

August 2007

This document was produced by Beyond Zero Emissions in response to the 'FutureGen Initial Conceptual Design Report' released in May 2007.

About FutureGen and the 'FutureGen Initial Conceptual Design Report'

The 'FutureGen Initial Conceptual Design Report' was created by the FutureGen Industrial Alliance, a public-private partnership who will attempt to design, build and operate the world's first coal-fueled, near-zero emissions power plant, at an estimated net project cost of US $1.5 billion.

The 'FutureGen Initial Conceptual Design Report' is available at:
http://www.futuregenalliance.org/publications/fg_icdr_052507_v2.pdf

About Beyond Zero Emissions

Beyond Zero Emissions Inc. is a not-for-profit, volunteer climate action group..

Our core goal is to facilitate the implementation of the social changes and technologies that will reduce the impacts of climate change and give our society, and today's global ecosystems, a chance of surviving into the future.

To achieve this humans must reduce our levels of atmospheric greenhouse emissions to zero, and we must do it soon.

Beyond Zero Emissions website: http://www.beyondzeroemissions.org

Introduction.

The FutureGen Industrial Alliance has released an 'Initial Conceptual Design Report' to investigate the feasibility of a ‘clean coal’ plant. Beyond Zero Emissions believes that the report is fundamentally flawed and largely an attempt to promote coal burning as a necessary part of future global energy.

In response we have produced this document, named the 'FutureGen Conceptual Design Retort’. Its aim is to highlight a range of questions regarding the viability of partial carbon capture and storage, often misnamed ‘clean coal’. Where applicable, specific reference has been made to the technology's relevance to Australia.

FutureGen Alliance's pre-emptive assumtion of a successful conclusion.

On page 5 of the Alliance's report it states that the project was initiated to determine 'if ' the technology is feasible, yet on the same page this is contradicted by the claim, “When successful, the FutureGen plant... will provide the basis for a new generation of reliable, environmentally benign, coal-fueled power plants...”

By preemptively assuming a successful outcome, the Alliance exposes its agenda to promote coal as a “... necessary part of a sustainable, global energy portfolio”, (refer pg 85) despite their own acknowledgement that the technology to eliminate CO2 produced by burning coal may not be feasible.

The coal industry's promise of ‘clean coal’ at some indeterminate date is an attempt to lull us into accepting the continued construction of coal-fired plants in contradiction of recommendations by eminent scientists. James Hansen, director of NASA's Goddard Institute for Space Studies, has stated that there should be a moratorium on building any more coal-fired power plants until the technology to capture and sequester the CO2 emissions is available. *(1)*

Cost competiveness.

Beyond Zero Emissions believes that the FutureGen plant will never be cost competitive when compared to renewable energy.

Table 2.1 on page 30 of the 'Initial Conceptual Design Report' shows the FutureGen Alliance's projected construction and operating schedule. The table shows that at the very earliest the plant will not be fully tested until 2017, when the 'Site Monitoring After Initial Operations' phase is completed. A major aim of this phase will be ongoing monitoring and the hopeful verification of the hypothetical sequestration system.

Even if we assume that the prototype partial carbon capture and storage plant is a success, a commercially operating plant will not be running until at least 2022.

This raises two important points:

Firstly, that by 2017 renewable energies are predicted to be cheaper than conventional coal. In fact, wind power in Australia is presently 7.5-8.5 cents per kWh. Projected prices of so-called ‘clean coal’, (i.e. coal power with CO2 capture and burial) starts at about 9 cents per kWh. *(2)*

Advances in wind power technology is driving down the cost of wind power to a point where it is becoming competitive with many other energy sources, even today. *(3)*. With this is mind, how can ‘clean coal’ ever be cost-competitive given that by 2022 renewable energy is predicted to be less expensive than even conventional coal? ‘Clean coal’, with the extra costs associated with transporting and capturing the carbon

emissions, will be more expensive still.

Secondly, wind power plants are already being constructed. One example is the Horse Hollow Wind Farm in Texas which is fully operational and has a capacity of 735 megawatts.*(4)*

In 2006, total installed global wind power capacity increased by 25%, and is expected to grow by an average of 19% per year up to 2010. *(5)* With many more wind farms coming onto the market, wind power is set to continue its spectacular growth.

Potential for salt water removal prior to CO2 sequestration.

On page 30 of the FutureGen report, reference is made to the potential need to pump brine, (salty water) out from underground reservoirs before CO2 can be pumped in. It states that the water in question "...may require cleanup before being sent to water disposal wells…"

Beyond Zero Emissions poses the question, 'What might need to be cleaned from the brine? Might it contain radioactive particles?'

In reference to underground injection control programs, the Bureau of Land and Water Quality in the U.S. state of Maine notes that "...brine is often saltier than seawater and can contain toxic metals and radioactive substances." *(6)*

Naturally occurring underground deposits of pressurised CO2.

Looking more deeply at the report, one thing that has been missed by most analysis of these issues is the fact that there are already naturally-occurring deposits of pressurised CO2 underground and occasionally they erupt.

CO2, being slightly heavier than air, can form a blanket at ground level that extinguishes all oxygen based life including our own. *(7)*

In 1986, the Lake Nyos crater in Cameroon released 1.2 km3 of CO2 in approximately 20 seconds. Nearly 1,800 people and more than 3,000 cattle and countless wild animals, birds and insects died from suffocation as a result. *(8)(9)* This amount of CO2 is the equivalent of approximately 2.5 years worth of the FutureGen plant's capacity.

In 1989, at a site in California, earthquakes occurring beneath Mammoth Mountain volcano released large amounts of CO2 killing trees on the mountain. "The U.S. Geological Survey (USGS) continues to study the CO2 emissions to help protect the public from this invisible potential hazard." *(10)*

The Mammoth Mountain site releases 300 tons of CO2 per day. Page 16 of the FutureGen report documents the plan for the trial power plant to sequester over a million tons of CO2 per year. That equates to more than nine times the daily amount released by Mammoth Mountain.

Penalities associated with processing lignite, (brown coal).

The FutureGen report states on page 18 that bituminous and sub-bituminous coal will be the main types of coal processed. It also mentions that lignite, often referred to as brown coal, can be processed, "albeit with significant efficiency and output penalties".

Given that coal power in Victoria is derived from lignite, it means that a FutureGen-like facility would not be suitable in Victoria.

Brown coal resources in the Latrobe Valley of Victoria represents 20 per cent of the world's reserves. "They have provided most of the fuel for Victoria's electricity generation industry since the 1920s..." *(11)*

Potentially prohibitive water volume requirements.

Page 24 of the FutureGen report describes how water is added to the heated coal, CO + H2O -> CO2 + H2.

Does this mean that 'clean coal' requires significantly more water than current coal power stations? If so, then this alone may make a partial carbon capture and storage plant unsuitable for Australian states given our current, and long-term forecast, water shortages.

Potentially prohibitive costs due to transmission piping.

Page 36 of the FutureGen report reveals a great deal of uncertainty over the cost of the transmission piping required to carry the CO2 to a storage area. Of all the infrastructure capital costs, transmission piping is the cause of greatest uncertainty.

With transmission piping potentially being the greatest capital expense, it seems to indicate that power plants need to be near rock formations suitable for sequestration if the plant is to have any chance of making a profit. Page 37 shows that the FutureGen Alliance and its investors are planning to lose money on this first power plant, and are not expecting to break even on operating costs on the last year when production is ramped up!

As the world's largest coal exporter, Australia is also keen to prove the viability of 'clean coal' with a proposed partial carbon capture and storage plant named ZeroGen. This initiative by the Queensland government has been criticised in respect to the large distances proposed for the transmission of the CO2. Even the Australian coal industry is sceptical about the plan to pipe carbon dioxide from the Stanwell power plant in Rockhampton, Queensland, 220km away for geological storage.*(12)*

CO2 compression costs may lead to financial failure.

Page 33 of the FutureGen report states they aim to have carbon capture and storage (CCS) for no more than 10% higher cost than other Integrated Gasification Combined Cycle (IGCC) coal-fired power plants.

How much energy does it take to compress the CO2 to a liquid and pump it underground? If that energy approaches 10% of the energy produced by the power plant then the project will be a failure.

Page 44 re-iterates the fact that "DOE (Department of Energy) has established a target of a 10% increase in the cost of electricity with CO2 capture compared to an IGCC plant without capture for the nth commercial plant".

How much more expensive is electricity generated from wind power?

IGCC plants are currently not cost competitive in the North American Electricity market, so how could the added impost of having to sequester their atmospheric carbon gases be economical?

Potential unstable rock formation.

What happens if a rock formation proves unstable? Are there plans to remove the CO2 and sequester it somewhere else? If so how much will it cost?

Is 90% CO2 sequestration viable?

On page 44 of the FutureGen report the Alliance has a stated aim to determine "...what fraction of capture between 75% and 100% is economically optimal and technically feasible." This seems to be an acknowledgement that capturing 90% of the CO2 might not be viable, hence our decision to always enclose the term 'clean coal' with inverted commas.

Conclusion.

Beyond Zero Emissions believes that the FutureGen Alliance report is fundamentally flawed and is largely an attempt to use a hypothetical technology, commonly misnamed 'clean coal', to promote coal burning as a necessary part of future global energy.

The FutureGen plant won't be fully tested until 2017 and a commercial plant will not be ready until 2022 at the earliest. This means that existing coal-fired plants will be pumping massive quantities of CO2 into the atmosphere for many years before 'clean coal' becomes commercially available, assuming it ever does.

Given that wind and solar power are proven technologies, Australia should embrace these technologies and spurn the dirty, high CO2 emitting coal-fired option.

In May of 2007 a team of scientists from NASA's Goddard Institute, led by Dr. James Hansen, released a peer-reviewed paper that predicts humans have less than ten years to make substantial reductions in global greenhouse gas emissions to avoid dangerous climate change.*(13)*

In consideration of the long time-scale and the multitude of unanswered questions hanging over this hypothetical carbon capture and storage technology, Beyond Zero Emissions suggests that it would be preferable for Australia to implement large-scale wind power and other zero emission technologies now, rather than wait many years to see if CO2 sequestration ever becomes viable.

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